The Idaho Explosives Detection System interrogates a mail delivery vehicle before it enters Wright-Patterson Air Force Base.

The Energy of Innovation

INL
Idaho National Laboratory

Idaho Explosives Detection System

The threat of an explosive terrorist attack on infrastructures and interests within the United States – such as military bases, government buildings and national monuments – is ever present. In the last five years, rudimentary and easily constructed devices such as roadside bombs and vehicle-borne improvised explosive devices have become a common tactic used by insurgents in countries like Iraq and Afghanistan.

For security professionals, dealing with explosive devices hidden in cars and trucks is a particularly difficult tactic to confront because large vehicles like cargo trucks and moving vans act as their own delivery mechanism and can move large amounts of explosive material without drawing suspicion. The

1995 bombing of the Alfred P. Murrah Federal Building in Oklahoma City provided a vivid example.

In collaboration with the United States Air Force Electronics Systems Center, scientists at Idaho National Laboratory have developed and deployed a portal-style vehicle-borne detection unit known as the Idaho Explosives Detection System (IEDS). In 2006, IEDS was installed at Ohio's Wright-Patterson Air Force Base for random anti-terrorism field testing.

How it Works

The award-winning IEDS is designed to nonintrusively interrogate cargo trucks before they get near high-profile targets like federal buildings or foreign embassies. The detection system functions similar

to an automated car wash. As cargo vehicles approach a facility, they are directed to drive into an open-air inspection zone. Once the driver exits the vehicle and proceeds beyond a 30-foot safety area, two 25-foot metal racks – one on each side of the vehicle – enclose like brushes in a car wash.

The system's effectiveness relies on a technique called pulsed thermal neutron activation. In this setup, two neutron generators saturate the vehicle with pulsed neutrons. This interrogation causes the molecular makeup of materials inside the vehicle to excite and emit gamma rays. Following each neutron pulse, a series of 32 sodium-iodide detectors measures signature gamma rays from the material present.

The entire interrogation process takes less than 300 seconds. At the end of the interrogation, IEDS will alert the operator whether explosives were detected. The inspection process scans the entire truck at once and is up to three times faster than a manual inspection while leaving no residual impact on the truck or cargo items. Accurate identification of explosives relies on patented mathematical algorithms written by INL researchers. Large amounts of raw data from the detectors are fed into the control computer. The algorithms interpret the data and feed it into a custom graphical user interface, which displays a simple-to-understand pass or fail icon. This simplistic design was built intentionally for a technician or soldier to operate with minimal training.

In addition, IEDS doesn't require continuous human interface, so operators can control the unit remotely from a secure location using Ethernet transmission.

IEDS was designed to detect the presence of nitrogen-based explosives with a minimum accuracy rate of 95 percent, and a false positive rate of less than 5 percent. Nitrogen is a common component found in over 98 percent of explosives. The INL team also designed the system to monitor the health of its individual components, so an operator could quickly pinpoint potential problems and make adjustments.

Custom Applications

Through the combination of rapid neutron interrogation and the use of high probability statistical inference, the IEDS has the ability to yield precise determination of the presence of explosives, while minimizing the indication of false positives. The current system has been developed for all-weather environments, allowing it to function accurately in desert and sub-zero environments. IEDS can be configured to detect a range of contraband items, or built for custom installation applications.

Key Capabilities

- Detects explosives:
  - A fraction of the size of those used in Oklahoma City
  - Concealed in any location on a vehicle
  - Within 300 seconds (five minutes)
  - such as ANFO, HMX, PETN, RDX, TNT, etc.
- Detects radiological material
- Proven technology
- Operationally safe
- Non-destructive, non-intrusive, non-contact

System Components

- Neutron generators
- Large array of sodium iodide (NaI) detectors
- Laptop computer

For more information

**Andrew Edwards
INL Program Manager**

208-526-8358
Andrew.Edwards@inl.gov

**Edward Reber, Ph.D.
Technical Lead**

208-526-1410
Edward.Reber@inl.gov

A U.S. Department of Energy National Laboratory

The Idaho Explosives Detection System can be configured for custom applications such as interrogating semitrucks for contraband items.

07-GAS0070-02

07-50651